

## **TOOL-LESS ATTACHMENT AND REMOVAL OF COMPONENTS IN A COMPUTER ENCLOSURE**

Inventors: Brooks I. Davis and Michael J. Freitas

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This is a continuation-in-part that claims priority under 35 U.S.C. § 120 to U.S. Patent Application No. 10/403,794, filed on March 23, 2003, entitled "Universal Computer Enclosure," and is related to U.S. Patent Application No. <xx/xxx,xxx> filed on January 30, 2004, entitled "Zero Rack Unit Space Utilization," both of which are incorporated by reference herein in their entirety.

### **FIELD OF THE INVENTION**

[0002] This invention relates to computer-related device storage, and more particularly to a tool-less feature for attachment, removal, and adjustment of computer system components in a computer enclosure.

### **BACKGROUND OF THE INVENTION**

[0003] Modern businesses make increasing use of multiple computer devices and equipment, such as servers. These computer system components are typically placed in specialized cabinets for use and storage. The Electronic Industries Association has produced a standard, EIA-310-D, for these specialized cabinets. The cabinets have rails on the left and right sides near the front of the cabinet with mounting holes. The multiple

computer devices and the associated computer equipment are attached at various locations along the rails or frames of the cabinet using the holes for mounting.

[0004] Tools, such as screwdrivers and the like, are typically used for attachment and removal of the computer devices and equipment. However, in cabinets that are filled with various types of computer system components, there might be only minimal extra space for maneuvering with tools. Thus, in these cramped spaces, it can be difficult to manipulate the tools in order to firmly and easily attach, remove, or even adjust the computer components, and to place components in the most space-effective positions.

[0005] It is often necessary to move around or slightly adjust components in a cabinet. Sometimes the current devices and equipment are modified or replaced, necessitating reorganization of the cabinet. At times, the computer system components may need to be repaired or adjusted, requiring access to the stored equipment that may be difficult to reach without a cumbersome disassembly of the cabinet. To manage these problems, it may be necessary to arrange the equipment so that it is easily reachable with tools for adjustment. However, space is then wasted as the equipment cannot be positioned in the most effective manner, but is instead positioned only in areas in which tools can be maneuvered. Thus, there are some spaces in the cabinet where equipment simply cannot be mounted.

[0006] In addition, even for the computer system components that are positioned in the cabinet so that they can be reached with tools, often only tools of certain sizes and shapes can be used. It can be costly and time-consuming to have such appropriately designed tools available for all types of computer devices and equipment in all cabinets in which they are stored. As new equipment is added or current equipment is

reorganized, new tools may have to be purchased to accommodate the adjusted space requirements.

[0007] Modern businesses often use different types of computer devices and equipment from a number of different manufacturers. While a few computer equipment manufacturers provide equipment that includes mechanisms for clipping or snapping equipment into computer cabinets, these mechanisms still do not solve the problem. These attachment mechanisms are difficult to snap into place and do not firmly and securely mount the equipment such that it cannot be accidentally rotated or knocked out of position. In addition, these attachment mechanisms are typically designed to work with specific types of equipment from particular vendors, or are incorporated as a part of the equipment itself. Thus, these attachment mechanisms do not provide a universal solution for difficult attachment and removal of computer equipment from various vendors. Custom tools are still required for difficult maneuvering to reach the equipment that does not have any sort of attachment mechanism that is designed specifically for that equipment. Cabinets still cannot be space-efficiently arranged, but must be organized to allow at least some tool manipulation.

[0008] Accordingly, it is desirable to provide a mounting device for use in a computer cabinet that allows easy, secure mounting and removal of equipment from several different vendors in a space-efficient manner.

### SUMMARY OF THE INVENTION

[0009] The invention provides a tool-less apparatus and method for attachment, removal, and adjustment of computer system components in a computer enclosure or storage cabinet. A bracket apparatus has features that allow for its easy attachment to and removal from support structures and frame tracks in a storage cabinet. In addition, the bracket apparatus has features that allow computer system components from multiple different vendors to be easily and securely attached to the bracket apparatus. Thus, the bracket apparatus can be placed in a desired, space-efficient location in a storage cabinet, such that components can be attached to the bracket apparatus in these space-efficient locations. The components can also be easily released from the apparatus for removal from or adjustment within the cabinet.

[0010] In one embodiment of the present invention, the bracket apparatus comprises at least one fastener coupled to a frame, and the fastener is adapted for connecting to an enclosure. The bracket apparatus further comprises at least one guide pin coupled to the frame, and the pin or pins are adapted to receive a computer component. In addition, the bracket apparatus comprises a release member that is resilient and is coupled to a frame. The release member is adapted to attach and release a computer component from the bracket apparatus. In this embodiment, the bracket apparatus is a two-piece device that can be assembled into a complete bracket apparatus for mounting computer components in an enclosure.

[0011] The bracket apparatus can be configured in a number of ways. In some embodiments of the present invention, a computer component is attached to an enclosure using two different brackets for attachment. For example, one type of bracket can be

used for attaching one side of the component, while a different type of bracket can be used for attaching the other side of the component. In one embodiment, the bracket used for attaching one side of a computer component is a two-part apparatus that can be assembled into a complete bracket. This bracket comprises a pocket in which one side of the computer component rests while pins or tabs hold the component in place. The bracket for attaching the other side of the component comprises at least one guide pin for engaging the computer component and a release member that releasably engages the computer component. Both brackets further comprise at least one fastener for attaching the bracket apparatus to an enclosure.

[0012] In a further embodiment, the bracket apparatus comprises a pivotable bar that pivots to secure the computer component to the bracket apparatus. The apparatus further comprises at least one guide pin for engaging the computer component and a release member for releasing the component from the apparatus. A notched member is coupled to the pivotable bar, and a notched edge engages a threaded portion on the release member to secure the component in place.

[0013] In addition to the bracket apparatus, another embodiment of the invention comprises a system for mounting computer components in an enclosure. The system comprises a means for securing and unsecuring a computer component to a support member in an enclosure. In addition, the means is further adapted to be attached to and detached from a support member in an enclosure. In this system, the securing and unsecuring of the computer component occurs without the use of tools, as does the attaching and detaching of the means from the support member.

[0014] In further embodiments, the invention comprises a method of attaching and detaching computer components in an enclosure. In one embodiment, the invention comprises a method for attaching computer components in an enclosure by attaching a bracket or mounting apparatus to the enclosure and attaching a computer component to the mounting apparatus. The method comprises connecting a mounting apparatus to a support member of an enclosure by attaching at least one fastener of the mounting apparatus to the enclosure. The method further comprises engaging the computer component with at least one guide pin of the mounting apparatus, and securing the component to the mounting apparatus by engaging the component with a release member of the mounting apparatus. In this method, at least one of the steps can occur without the use of tools.

[0015] In a further embodiment, the invention comprises a method for detaching computer components in an enclosure by detaching the computer component from the mounting apparatus and detaching the apparatus from the enclosure. The method comprises unsecuring the computer component from the mounting apparatus by manipulating a release member on the apparatus to disengage the component. The method further comprises disengaging the computer component from at least one guide pin of the mounting apparatus. In addition, the method comprises disconnecting a mounting apparatus from a support member of the enclosure by detaching at least one fastener of the mounting apparatus from the enclosure.

[0016] The features and advantages described in the specification are not all inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it

should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0017] Figure 1 is a perspective view of the front, top, and left side of an assembled bracket according to one embodiment of the present invention.

[0018] Figure 2 is a perspective view of the rear, top, and left side of an assembled bracket according to one embodiment of the present invention.

[0019] Figure 3 is a perspective view of the front, top, and left side of a part of a disassembled bracket according to one embodiment of the present invention.

[0020] Figure 4 is a perspective view of the front, top, and left side of a part of a disassembled bracket according to one embodiment of the present invention.

[0021] Figure 5 is a side view of the assembly of the two parts of a bracket according to one embodiment of the present invention.

[0022] Figure 6 is a side view that illustrates a computer component mounted on a bracket according to one embodiment of the present invention.

[0023] Figure 7 is a perspective view that illustrates the mounting of a computer component on two brackets according to one embodiment of the present invention.

[0024] Figure 8 is a side view that illustrates a mounted computer component according to one embodiment of the present invention.

[0025] Figure 9a is a perspective view of a computer enclosure that illustrates computer components mounted within the enclosure according to one embodiment of the present invention.



[0026] Figure 9b is a magnified perspective view of a portion of Figure 9a that illustrates a computer component attached to a frame track using the bracket apparatus according to one embodiment of the present invention.

[0027] Figure 9c is a magnified perspective view of a portion of Figure 9a that illustrates a computer component screwed onto a frame track.

[0028] Figure 10 is a perspective view of a computer enclosure that illustrates both servers and computer components mounted within the enclosure according to one embodiment of the present invention.

[0029] Figure 11 is a perspective view of the front, top, and left side of an assembled bracket according to one embodiment of the present invention.

[0030] Figure 12 is a perspective view of the front, top, and left side of a part of a disassembled bracket according to one embodiment of the present invention.

[0031] Figure 13 is a perspective view of the front, top, and left side of a bracket according to one embodiment of the present invention.

[0032] Figure 14 is a side view that illustrates a computer component mounted to two brackets according to one embodiment of the present invention.

[0033] Figure 15 is a perspective view of the front, top, and left side of a bracket in an open position according to one embodiment of the present invention.

[0034] Figure 16 is a perspective view of the front, top, and left side of a bracket in a closed position according to one embodiment of the present invention.

[0035] Figure 17 is a side view of a bracket in a partially open position according to one embodiment of the present invention.

[0036] Figure 18 is a side view of a bracket in a closed position according to one embodiment of the present.

[0037] Figure 19 is a flow chart illustrating a method of attaching computer components in an enclosure according to one embodiment of the present invention.

[0038] Figure 20 is a flow chart illustrating a method of detaching computer components from an enclosure according to one embodiment of the present invention.

[0039] The Figures depict embodiments of the present invention for purposes of illustration only. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein might be employed without departing from the principles of the invention described herein.

## DETAILED DESCRIPTION OF THE INVENTION

[0040] The present invention provides for easy and space efficient attachment and removal of computer components from an enclosure, without requiring the use of tools for attachment or removal.

[0041] As used herein, the term “computer component” can include any type of computer device or equipment that might be stored in an enclosure by being received by and attached to a mounting apparatus that itself is attached to the enclosure. For example, a computer component can be a server, power strip or other power unit, a temperature-sensing device or other sensor, a fan or other cooling device, a camera, etc. Computer components are not limited to components from any particular vendor, but instead can include components from any number of different vendors. For example, vendors can include IBM, Dell Computer, Sun Microsystems, Hewlett-Packard and Compaq, etc.

[0042] As used herein, the term “enclosure,” “computer enclosure,” “cabinet,” “computer cabinet,” and “storage cabinet” can include any type of enclosure used for storing computer devices and equipment. In some embodiments, the enclosure conforms to the EIA-310-D standard for computer cabinets that has been produced by the Electronic Industries Association. In some embodiments, the enclosure also or alternatively conforms to other requirements set by various computer device and equipment vendors. In still further embodiments, the enclosure conforms to another standard or does not conform to any particular standard, but simply includes features providing extra flexibility so that many different computer devices from different vendors may be stored in the cabinet.

[0043] Referring to Figure 1, there is shown an assembled bracket apparatus according to one embodiment of the present invention. In this embodiment, the bracket apparatus 100 is a two-part apparatus. Figure 1 illustrates the two parts of the bracket apparatus 100 assembled to form the complete bracket apparatus 100. The bracket apparatus 100 comprises a frame 112 that supports two guide pins, a right guide pin 102 and a left guide pin 103, onto which mounting holes of a computer component can be positioned. Though Figure 1 illustrates a bracket apparatus 100 with a right guide pin 102 and a left guide pin 103, the bracket apparatus 100 can alternatively have just one guide pin, or more than two guide pins to which mounting holes of a computer component can be attached. Also shown in Figure 1 is a release plunger 104 for releasing the bracket apparatus 100 from the enclosure. Two resting ledges, a right resting ledge 116 and a left resting ledge 117, are attached to either side of the frame 112, and these resting ledges support a computer component during attachment to the bracket apparatus 100. Also illustrated in Figure 1 is a release flap or release member 110 that protrudes through a slot in the frame 112. The release member 110 assists in securing a computer component to the bracket apparatus 100, and provides for the release of the component from the apparatus 100.

[0044] Referring now to Figure 2, there is illustrated a perspective view of the rear, top, and left sides of the bracket apparatus 100, according to one embodiment of the present invention. In Figure 2, two anti-rotation tabs, a right anti-rotation tab 206 and a left anti-rotation tab 208, are visible. These tabs assist in securing a computer component to the bracket apparatus 100 such that the component is locked into place and cannot be easily rotated or accidentally detached from the apparatus 100.

[0045] Figure 3 illustrates the main part 300 of the disassembled two-part bracket apparatus 100, according to one embodiment of the present invention. In one embodiment, a frame 112 of the main part 300 comprises an upper frame 340 to which is attached the right guide pin 102, the left guide pin 103, the right resting ledge 116, and left resting ledge 117. The main part 300 also comprises a frame base 314, to which three fastener arms are attached, and the frame base 314 further comprises a plunger insertion hole 304. The plunger insertion hole 304 holds the release plunger 104, and the tip of the release plunger 104 protrudes through the hole, as shown in Figure 1. In one embodiment, the three fastener arms comprise a right front fastener arm 306, a left front fastener arm 307, and one rear fastener arm 308. These fastener arms attach to a support structure of an enclosure to secure the bracket apparatus 100 into position. The invention is not limited to only three fastener arms, but instead there can be one or more fastener arms according to some embodiments of the invention. A lower spot weld alignment hole 302 is illustrated in the frame base 314. This hole permits alignment of the two parts of the bracket apparatus 100 for the welding together of the two parts. A release slot 310 in the upper frame 340 allows for insertion of the release member 110 that is shown in Figure 1.

[0046] Referring now to Figure 4, there is shown the insertion part 400 of the disassembled two-part bracket apparatus 100, according to one embodiment of the present invention. The frame of the insertion part 400 comprises an insertion base 402 and an insertion body 404. An upper spot weld alignment hole 408 in the insertion base 402 provides for alignment of the two parts of the bracket apparatus 100. The upper spot weld insertion hole 408 can be aligned, as shown in Figure 1, with the lower spot weld

insertion hole 302 to permit alignment of the two parts of the bracket apparatus 100 such that the two parts can be welded together if desired. The right anti-rotation tab 206 and the left anti-rotation tab 208 are attached to the insertion body 404, as is the release member 110.

[0047] Though the bracket apparatus 100 shown in Figures 1-4 is illustrated as being a two-part apparatus, the bracket apparatus 100 can also be a one-part apparatus. In some embodiments, the main part 300 and the insertion part 400 are not detachable from each other.

[0048] In assembling the two-part apparatus, the release member 110 can be inserted into the release member slot 310 in the direction 502 shown in Figure 5, in one embodiment of the invention. Additionally, the insertion base 402 can be inserted through the release member slot 310, such that the insertion base 402 rests on top of the frame base 314. When assembled, the release member 110 protrudes through the release member slot 310 in the upper frame 340. The right anti-rotation tab (not shown) and the left anti-rotation tab 208 prevent the release member 110 from being pulled more than a set distance through the release member slot 310 by bracing the insertion part 400 against the upper frame 340.

[0049] Referring now to Figure 6, there is shown the bracket apparatus 100 with a portion of a computer component 600 attached to the apparatus 100, according to one embodiment of the present invention. As shown in Figure 6, the computer component 600 can be easily slid onto and off of the bracket apparatus 100. To attach the computer component 600 to the bracket apparatus 100, the component 600 is slid onto the right guide pin (not shown) and the left guide pin 103, and the release member 110 is pushed

toward the frame base 314. The component 600 pushes the release member 110 in the direction 602 shown in the figure as the component 600 is slid along the right guide pin (not shown) and the left guide pin 103 toward the upper frame 340. Once the computer component 600 has moved a certain distance along the guide pins, the release member 110 can return to its original position. When the computer component 600 has been fully engaged by the bracket apparatus 100, the component 600 will be secured between the upper frame 340 and the release member 110, as shown in Figure 6.

[0050] Figure 7 illustrates the attachment of two bracket apparatuses 100 to either end of a computer component 600, according to one embodiment of the present invention. In this illustration, the component 600 is a power source, but the component 600 can be different types of computer equipment as described above. As shown in Figure 7, the component 600 can include mounting holes 702 that allow the component 600 to be attached to the bracket apparatus 100. These mounting holes 702 are shown as somewhat oval-shaped holes in the Figure, however these holes can take any shape. For example, the holes 702 might be round or square, or the holes 702 might include some type of adapter for adjusting the shape and/or size of the holes 702. In addition, there can be any number of mounting holes 702 that arranged in various configurations and located in various positions on the computer component 600. In some embodiments, only one bracket apparatus 100 may be needed to mount components, and in other embodiments, more than two bracket apparatuses will be used to mount components. Figure 7 illustrates two bracket apparatuses 100 facing in reverse directions for mounting the computer component 600. In other embodiments, the apparatuses 100 might be configured in different manners, including facing in the same directions for mounting.

[0051] Figure 8 shows the computer component 600 fully engaged with the bracket apparatus 100, according to one embodiment of the present invention. In this embodiment, there is a bracket apparatus 100 attached to the mounting holes 702 in the top and the bottom of the component 600, and the bracket apparatuses 100 are attached in reverse directions. The computer component 600 is slid in the direction 800 shown to attach the component 600 to the two bracket apparatuses 100. The right guide pin 102 and the left guide pin 103 of the apparatuses 100 are protruding through the mounting holes 702, and the component 600 is positioned between the upper frame 340 and the release member 110. The right anti-rotation tab 206 and left anti-rotation tab 208 assist in holding the release member 110 against the component 600 such that the component 600 cannot be easily rotated or knocked out of position.

[0052] Referring now to Figure 9a, there is illustrated an enclosure 900, according to one embodiment of the present invention. The enclosure 900 comprises a number of vertical and horizontal support structures containing holes 940 to which bracket apparatuses 100 can be attached. Figure 9a shows four vertical supports, including a right front support member 916, a right rear support member 918, a left front support member 920, and a left rear support member 922. Figure 9a also shows a number of horizontal supports or frame tracks, including a right upper frame track 924, a right upper middle frame track 902, a right lower middle frame track 904, a right lower frame track 906, a left upper frame track (not shown), a left upper middle frame track 910, a left lower middle frame track 912, and a left lower frame track 914. These support structures can vary in number and configuration in the enclosure 900, and can also vary in width, length, and height.



[0053] Figure 9a illustrates computer components attached at various locations along the frame tracks. The computer components 600 can be attached along one frame track or can be attached in a manner that utilizes more than one frame track. For example, a component 600 might be attached by a bracket apparatus 100 at one end to the right upper frame track 924 and by a bracket apparatus 100 at the other end to a right upper middle frame track 902. In the same manner, a component might be attached to both the right upper middle frame track 902 and the right lower middle frame track 904, or the right lower frame track 906 and the right lower middle frame track 904. In addition, a component might also be attached to the left side frame tracks in the same manner.

[0054] These various attachment configurations allow for space efficiency within the enclosure 900. For example, as shown in Figure 9a, a first power source 950 can be attached in a space efficient vertical configuration, in addition to the horizontal configuration of the second power source 952. The second power source 952 is attached using screws or some other attachment mechanism that requires tools. The second 952 power source must be positioned such that it is not too close to either of the front or rear support members, since there must be space for maneuvering tools for attaching and removing the power source. Two horizontally positioned power sources will not fit on one frame track, thus wasting space in the enclosure. The horizontal position further uses up many of the mounting holes on a frame track by covering them up with the body of the power source 952. In addition, even if a power source were attached with tools in a vertical configuration, space is still wasted because again the power sources cannot be positioned too close together or too close to the vertical support structures where they cannot be accessed by tools. Thus, the tool-less attachment of the bracket apparatus 100

to the enclosure 900 and the attachment of the components 600 to the apparatus 100 allows for a much easier attachment and removal so space in the cabinet is effectively used.

[0055] The frame track structures also provide for effective use of the zero units space in the enclosure 900. According to the EIA-310-D standard, the space within an enclosure 900 is measured in rack units that are approximately 1.75 inches each, or are three support structure mounting holes 940 in length. Each server mounted within an enclosure 900 takes up a certain amount of rack unit space along the vertical support structures in the enclosure 900. However, a certain amount of space is left open along the sides of the cabinet for ventilation, etc. and this open space is referred to as the zero units space. The frame tracks run horizontally along this zero units space and allow a place for computer components to be attached. The bracket apparatus 100 works together with the frame tracks to permit easy attachment and easy removal of components 600, so the zero units space can be fully utilized in an effective manner.

[0056] The bracket apparatus 100 can also be used to attach components to the vertical support structures or support members. For example, the bracket apparatuses 100 might be used to attach a server to the right front support member 916, the right rear support member 918, the left front support member 920, and the left rear support member 922.

[0057] Figure 9b illustrates a close-up view of the first power source 950 attached to a frame track using a bracket apparatus 100 in accordance with one embodiment of the present invention. The bracket apparatus 100 allows the first power source 950 to be easily snapped onto and off of the frame track. Figure 9c illustrates a close-up view of the support mounting holes 940 of a frame track with the second power source 952

attached by screws. While the support mounting holes 940 are illustrated as square holes, the holes 940 can be any shape as described above in reference to mounting holes 702.

[0058] Referring again to Figure 9b, the first power source 950 is securely attached to the bracket apparatus 100, which is in turn securely attached to the support mounting holes 940 of the frame track. The right front fastener arm 306 and the left front fastener 307 along with the rear fastener 308 are each attached to a different support mounting hole 940. In addition, the tip of the release plunger 104 is attached to a mounting hole. The bracket apparatus 100 can be moved against the frame track to slide the fasteners, including the release plunger 104, into the support mounting holes 940 and snap the fasteners and the plunger into position. Once the bracket apparatus 100 is secured to the frame track, the first power source 950 can be easily snapped onto and off of the apparatus 100. The bracket apparatus 100 can be detached from the frame track by pulling the release plunger 104 in a direction 970 away from the frame track, such that the tip of the release plunger 104 is removed from the support mounting hole 940. The bracket apparatus 100 can then be slid off of the frame track by moving the apparatus 100 against the frame track in a direction opposite that used to attach the apparatus 100. This will unsnap the fastener arms from the support mounting holes 940 to free the apparatus 100.

[0059] Figure 10 illustrates the enclosure 900 of Figure 9a with servers 1080 attached inside. This Figure 9b further illustrates the difficulty in accessing the computer components 600 with tools. The servers 1080 take up a large amount of space in the

enclosure 900, making it difficult to maneuver near the components 600 with tools for attachment, removal, or adjustment of position of the components 600.

**[0060]** Referring now to Figure 11, there is shown a bracket apparatus 1100 according to one embodiment of the present invention. In this embodiment, the bracket apparatus 1100 is a two-part apparatus. Figure 11 illustrates the two parts of the bracket apparatus 1100 assembled to form the complete bracket apparatus 1100. The bracket apparatus 1100 comprises a frame 1112 that supports two guide pins or guide tabs, a right guide tab 1102 and a left guide tab 1103, onto which mounting holes of a computer component can be slid. The frame 1112 comprises an upper frame 1140 and a frame base 1114. The apparatus 1100 further comprises a resting ledge 1116, and between the resting ledge 1116 and upper frame 1140 is a resting pocket 1150. A computer component can be positioned such that an edge of the component rests in the resting pocket 1150 against the resting ledge 1116, thereby supporting the component.

**[0061]** Right guide tab 1102 and left guide tab 1103 allow for the securing of a component to the bracket apparatus 1100, according to one embodiment of the present invention. The two guide tabs are arranged such that a computer component can be easily slid against the two tabs and snapped into position. The right guide tab 1102 and the left guide tab 1103 are pressed toward the frame 1112 of the bracket apparatus 1100 as the computer component is slid against the tabs toward the frame base 1114 of the apparatus 1100. When the component has been moved against the tabs a certain distance, the guide tabs are released from the pressed position, and can return to their original extended position. The right guide tab 1102 and the left guide tab 1103 engage the mounting holes of a computer component and are locked inside the mounting holes

such that the computer component is secured to the bracket apparatus 100 and cannot be pulled away from the frame base 1114. Though Figure 11 illustrates a bracket apparatus 1100 with two guide tabs, the bracket apparatus 1100 can alternatively have just one tab 10 or more than one tab to which a component can be attached.

[0062] The right guide tab 1102 and the left guide tab 1103 also allow for the unsecuring of a computer component from the bracket apparatus 1100, according to one embodiment of the present invention. The right guide tab 1102 and left guide tab 1103 are pressed toward the upper frame 1140, thereby disengaging the mounting holes of a component and freeing the component such that it can be pulled away from the bracket apparatus 1100.

[0063] Additionally, Figure 11 illustrates fasteners that can be used to attach the apparatus 1100 to an enclosure. In one embodiment, the apparatus 1100 is moved in one direction such that the right front fastener 1106, the left front fastener 1107, and the rear fastener 1108 engage holes in a support member or frame track of an enclosure to lock the apparatus 1100 into position. The apparatus 1100 is moved in the opposite direction to slide the fasteners out of the holes and release the apparatus 1100 from the enclosure. Figure 11 also illustrates a release plunger hole 1104. The apparatus 1100 can have a release plunger for attaching to an enclosure, as described regarding apparatus 100, though such a release plunger is not required and is not shown in Figure 11.

[0064] Figure 12 shows the insertion part of the two-part bracket apparatus 1100, according to one embodiment of the present invention. The insertion part can be slid into a slot in the apparatus 1100 such that the insertion frame 1224 rests within the resting pocket 1150 of the apparatus 1100 that is shown in Figure 11.

[0065] Referring now to Figure 13, there is shown a one-part bracket apparatus 1300 in accordance with one embodiment of the present invention. In this embodiment, the bracket apparatus 1300 comprises a frame 1312 with an upper frame 1340 and a frame base 1314. The upper frame 1340 supports two guide pins, a right guide pin 1302 and a left guide pin 1303, to which the mounting holes of a computer component can be attached. Also illustrated in Figure 13 is a release flap or release member 1310 that connects with an insertion body 1324, and the release member 1310 protrudes through the open portion of the frame 1312. The release member 1310 assists in securing a computer component to the bracket apparatus 1300, and provides for the release of the component from the apparatus 1300. A right front fastener 1306, a left front fastener 1307, and a rear fastener 1308 secure the apparatus 1300 to the enclosure. In one embodiment, the apparatus 1300 further comprises a release plunger that rests in the release plunger hole 1304, and further assists in attaching the apparatus 1300 to an enclosure. However, such a release plunger is not required, nor is one shown in Figure 13.

[0066] Figure 14 illustrates both bracket apparatus 1100 and bracket apparatus 1300 attached to a computer component 600. Figure 14 shows the manner in which the edge of the component rests inside the resting pocket 1150, where the guide tabs can engage the mounting holes (not shown) to secure the component 600 in place. Further, Figure 14 illustrates how the component 600 is secured by the apparatus 1300 such that the mounting holes engage the right guide pin 1302 and the left guide pin (not shown). The release member 1310 also secures the component 600 in position. Pressing the release member 1310 toward the frame base 1314 allows the component 600 to be slid from the

pins and removed from the bracket apparatus 1300. In one embodiment, a component 600 is attached to apparatuses 1100 and 1300 by sliding an edge of the component 600 into the resting pocket 1150 of apparatus 1100 to lock the edge of the component 600 into position, and the other edge of the component 600 is pressed against apparatus 1300 to lock it into place. The component 600 is released from the apparatuses by pressing release member 1310 toward frame base 1314 so that component 600 can be slid off of the apparatus 1300, and the guide tabs (not shown) are pressed toward upper frame 1140 to disengage the mounting holes of the component 600 from the tabs and slide the component out of the resting pocket 1150.

[0067] Referring now to Figure 15, there is shown a multiple piece bracket apparatus 1500 with a pivotable bar 1552 for securing a component into position. The bracket apparatus 1500 comprises a frame 1512, including an upper frame 1540 and a frame base 1514. The upper frame 1540 supports two guide pins, a right guide pin 1502 and a left guide pin 1503, to which mounting holes of a computer component can be attached. Also shown in Figure 15 is a release plunger 1504 for releasing the bracket apparatus 1500 from the enclosure, as described above in relation to apparatus 100. Two resting ledges, a right resting ledge 1516 and a left resting ledge 1517, are attached to either side of the frame 1512, and these resting ledges support a computer component during attachment to the bracket apparatus 1500. Bracket apparatus 1500 further comprises a right front fastener 1506, a left front fastener 1507, and rear fastener (not shown) for attaching the apparatus 1500 to an enclosure, as described above.

[0068] In one embodiment, apparatus 1500 comprises a pivotable bar 1552 that secures a component onto the apparatus 1500. Figure 15 illustrates the apparatus 1500 in an

open position, where the pivotable bar 1552 is pivoted toward the frame base 1514. A pawl 1550, which is coupled to the pivotable bar 1552 is in an upright position.

[0069] Figure 16 illustrates the apparatus 1500 in a closed position, with the pivotable bar 1552 pivoted toward the upper frame 1540 and the pin engagement holes 1659 of the pivotable bar 1552 engage the guide pins, according to one embodiment of the present invention. A notched member 1654 is coupled to the pivotable bar 1552. Additionally, a release member 1658 is coupled to the frame base 1514. The release member 1658 further has a threaded portion 1656. The notched member 1654 engages the threaded portion 1656 to lock the pivotable bar 1552 into a closed position. Pressing the release member 1658 toward the frame base 1514 causes the notched member 1654 to be disengaged from the threaded portion 1656 such that the pivotable bar 1552 is free to pivot.

[0070] Figure 17 shows a side view of the apparatus 1500 in a partially closed configuration, where pivotable bar 1552 is pivoting toward the upper frame 1540, according to one embodiment of the present invention. A computer component can be slid along the right guide pin (not shown) and the left guide pin 1503 by pressing the component against the pawl 1550 when the pawl 1550 is in an upright position. This forces the pawl 1550 to begin pivoting toward the frame base 1514 and away from the upper frame 1540. In response to the movement of the pawl 1550, the pivotable bar 1552 begins to pivot toward the upper frame 1540. As the component further slides along the guide pins, the component pushes the pawl 1550, until the pivotable bar 1552 is forced into a closed position.



[0071] Figure 18 illustrates a side view of the apparatus 1500 in a closed position, according to one embodiment of the present invention. In this embodiment, the pawl 1550 is pressed fully away from the upper frame 1540, and the notched member 1654 has engaged the threaded portion (not shown) of the release member 1658, to lock the pivotable bar 1552 in a closed position. Thus, a component can be secured on the guide pins, between the upper frame 1540 and the pivotable bar 1552, and can be released by pressing the release member 1658 toward the frame base 1514.

[0072] Referring now to Figure 19, there is shown a method for securing computer components 600 to an enclosure 900, according to one embodiment of the present invention. Though this method specifically illustrates the use of bracket apparatus 100 for securing components 600, this general method can be used with any of the disclosed bracket apparatuses. In one embodiment, the bracket apparatus 100 is secured to a support structure of an enclosure 900. The bracket apparatus 100 is slid 1900 against the support structure in a direction such that the right front fastener arm 306, left front fastener arm 307, and rear fastener arm 308 can engage holes 940 in the support structure. This allows that bracket apparatus 100 to be locked onto the support structure. Also, sliding 1900 the component against the support structure will allow the tip of the release plunger 104 to engage a hole 940 of the support structure to further secure the apparatus 100 to the enclosure 900.

[0073] As illustrated in Figure 19, a computer component 600 can be secured to the apparatus 100. The component 600 is positioned above the apparatus 100 such that the mounting holes 702 of the component 600 can engage 1902 the right guide pin 102 and the left guide pin 103 of the apparatus 100. The component is slid 1904 along the pins

and against the release member 110, thereby pressing the release member 110 toward the frame base 314. When the component 600 has slid a certain distance along the guide pins such that the component 600 is adjacent to the upper frame 340, the release member 110 can return to its original position. The component 600 is secured 1906 to the apparatus 100 by being slid along the right guide pin 102 and the left guide pin 103 until the component 600 is engaged between the frame 112 and the release member 110.

[0074] Referring now to Figure 20, there is shown a method for unsecuring computer components 600 from an enclosure 900, according to one embodiment of the present invention. As discussed above, though this method specifically illustrates the use of bracket apparatus 100 for unsecuring components 600, this general method can be used with any of the disclosed bracket apparatuses. In one embodiment, the computer component 600 is released from the bracket apparatus 100 when the release member 110 is pressed 2050 toward the frame base 314. Pressing the release member 110 allows the computer component 600 to be slid 2052 past the release member 110 along the right guide pin 102 and the left guide pin 103, away from the frame 112. The component 600 can then be removed 2054 from the bracket apparatus 100.

[0075] As illustrated in Figure 20, the bracket apparatus 100 can be removed from the enclosure 900. In one embodiment, the release plunger 104 is pulled 2056 in a direction away from the frame base 114 and against the bias of a spring in the release plunger 104. Pulling 2056 the release plunger 104 removes the plunger tip from a hole 940 in the support structure in an enclosure 900. Once the plunger tip is removed from the hole 940, the apparatus 100 can be slid 2058 against the support structure in a direction opposite that used to attach the bracket apparatus 100. Sliding 2058 the bracket

apparatus 100 in this manner allows the right front fastener arm 306, the left front fastener arm 307, and the rear fastener arm 308 to be disengaged from the holes 940 in the support structure. Once the fastener arms are detached from the support structure, the bracket apparatus 100 can be removed 2060 from the enclosure 900.

[0076] The foregoing description of the embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Persons skilled in the relevant art can appreciate that many modifications and variations are possible in light of the above teaching. Persons skilled in the art will recognize various equivalent combinations and substitutions for various components shown in the figures. It is to be understood that the invention is not limited to the precise construction and components disclosed herein and that various modifications, changes, and variations may be made in the arrangement, operation, and details of the methods and apparatuses of the present invention without departing from the spirit and scope of the invention as it is defined in the appended claims.